

REMARKS

This is a response to the Office action that was issued on April 13, 2004, in connection with the above-identified patent application. Prior to entry of the above amendments, claims 1-53 were pending and rejected. By the above amendments, claims 22 and 45-46 are cancelled without prejudice, claims 1, 21, 23-24, 37, 39-40, 44, 47-49 and 52 are amended, and new claims 54-58 are added.

In the Office action, certain claims were rejected under 35 U.S.C. § 102(e). Claims 22-26, 28, 33-35, 37-38, 47, and 49-51 stand rejected as being anticipated by U.S. Patent No. 6,368,735 to Lomax. Claims 1-8, 10-14, 17, 21-22, 24-25, 31-35, 37-39, 45, and 48-49 stand rejected as being anticipated by U.S. Patent No. 6,294,276 to Ogino. In addition, claims 1-3, 5, 7, 9-10, and 20 were rejected as being anticipated by U.S. Publication No. 2004/0013918 to Merida-Donis. The remaining claims were rejected under 35 U.S.C. § 103. More specifically, claims 36 and 39-44 stand rejected as being obvious over Lomax in view of U.S. Patent No. 6,522,955 to Colborn. Claims 52 and 53 stand rejected as being obvious over Lomax in view of U.S. Patent No. 6,666,961 to Skoczylas. Claims 17-19 stand rejected over Lomax in view of U.S. Publication No. 2002/0041986 to Wojtowicz. Claims 4, 11-14, 21-22, 45-46, and 48 stand rejected as being obvious over Merida-Donis in view of Lomax. Claims 15 and 16 were rejected as being obvious over Ogino in view of U.S. Publication No. 2002/0004152 to Clawson. Claims 27 and 29 stand rejected as being obvious over Ogino in view of U.S. Patent No. 6,686,078 to Jones.

Applicants have studied the cited references in view of the pending claims. Applicants respectfully disagree that the subject matter of all of the original claims was

anticipated or rendered obvious by the cited references. However, Applicants have amended claim 1 to recite subject matter that is neither disclosed nor suggested in the cited references, individually or in any permitted combination thereof. In the following discussion, Applicants first discuss the amendment to independent claim 1, from which claims 2-58 now depend. The newly added claims are then discussed, followed by a discussion of the original pending claims. Applicants believe that this format may reduce the Examiner's time considering this response, such as in connection with the original dependent claims, after consideration of amended claim 1. With the allowance of claim 1, claims 2-58 should also be allowable. For the purpose of completeness, however, the dependent claims are discussed at the end of this response.

Amendment to independent claim 1

Claim 1 has been amended to recite a fuel cell system with a fuel processor that produces a product hydrogen stream, a hydrogen storage system that includes a mechanical compressor that compresses and stores under pressure at least a portion of the product hydrogen stream, and a fuel cell stack that is selectively adapted to simultaneously receive a stream containing hydrogen gas from the fuel processor and the hydrogen storage system, and to produce an electric current therefrom. As discussed in the present specification, a fuel cell system in which the fuel cell stack may selectively receive hydrogen gas from the fuel processor, from the hydrogen storage system, or both, enables a range of operating configurations that provides a more flexible, adaptable system. For example, when receiving hydrogen gas from both the fuel processor and the hydrogen storage system, the fuel cell stack is able to produce a sufficient electric current

to satisfy an applied load that exceeds the capacity that otherwise could be satisfied upon receipt of hydrogen gas from the fuel processor or the hydrogen storage system individually. Another potential benefit is the energy and efficiency savings of not having to store the entire product hydrogen stream and thereafter remove the stored hydrogen from storage, such as is required by the cited references. Instead, when the fuel processor is producing a product hydrogen stream, this stream may be used to satisfy the hydrogen demands of the fuel cell stack. Should the demand increase beyond the capacity of the fuel processor or beyond the currently available output of the fuel processor, the additional desired hydrogen may be provided by the hydrogen storage system. The selective dual sourcing of the hydrogen gas also enables the fuel cell system to quickly adjust to changes in the demanded hydrogen without having to exclusively draw the hydrogen gas from the storage system. As also discussed in the specification, these exemplary configurations are not required, in that the system also may be selectively used in a single-source configuration. However, the recited dual-source configuration provides a range of operative states that are neither disclosed nor suggested in the cited references. Instead, the cited references clearly require storage of the entire product hydrogen stream, with the hydrogen storage system being the exclusive source of hydrogen gas for the fuel cell stack.

Applicants agree with the Examiner that Ogino and Merida-Donis disclose fuel cell stacks that receive hydrogen streams from a hydrogen storage device. However, none of the references disclose or suggest a fuel cell stack that is adapted to simultaneously receive hydrogen from both a fuel processor and a storage system. The

disclosure of each of these cited references is discussed below to point out this distinction.

Ogino discloses a fuel cell stack (100) that is supplied with hydrogen solely from a storage system. The storage system is selectively charged by a fuel processor. In fact, Ogino actually requires two sequential storage devices, namely, an accumulator that stores the hydrogen gas produced by the fuel processor, and then a fuel tank on the electric vehicle that is periodically recharged by the stored gas in the accumulator. Although Ogino discloses multiple configurations and variations of this basic configuration, Ogino fails to disclose or suggest selectively providing hydrogen gas to the fuel cell stack directly from the fuel processor, much less from both the fuel processor and a hydrogen storage device. In fact, Ogino teaches away from a fuel cell stack adapted to receive hydrogen directly from the fuel processor when it states that the hydrogen generator supplier (10) “is free from the influence of the electric vehicle” and that “this arrangement ensures the reforming reactions [occur] under the optimum conditions and thereby realizes the high energy efficiency in the reformer.”

Merida-Donis only discloses a fuel cell stack (802) that is adapted to receive hydrogen from a fuel storage system (706), not from the fuel processor (801) directly. Even in embodiments where the fuel processor and the fuel cell stack are combined into an integrated apparatus, the fuel cell stack (901) of Merida-Donis is configured to only receive hydrogen gas from the hydrogen storage system (706). In the Merida-Donis system, “two-phase mixtures of hydrogen and water . . . are generated by electrolysis in the stack 901, which are collected and flow out of the URFC stack 901 through check valves.... Check valves ... prevent the two-phase mixtures 805 and 806

from returning to the URFC stack.” When the Merida-Donis two-phase hydrogen and water mixture has been separated, the hydrogen gas is stored, and only then may it supply the fuel cell stack.

For at least the above reasons, Applicants believe that a fuel cell stack adapted to simultaneously receive hydrogen streams from a hydrogen storage system and a fuel processor patentably distinguishes Ogino and Merida-Donis. As such, and upon consideration of amended claim 1, Applicants request that the rejections of claim 1 be withdrawn.

The remaining ones of claims 2-58 depend from amended claim 1 and therefore should be allowed when amended independent claim 1 is allowed. For the purpose of brevity, each of these dependent claims is not discussed in detail and each additional reason why these claims are believed to patentably distinguish the cited references is not presented. However, Applicants want to briefly discuss a few of these dependent claims and to present illustrative additional reasons that the claims should be allowed.

Claim 4 depends from claim 1 and recites that the hydrogen storage system further includes an electrochemical compressor that is adapted to receive at least a portion of the product hydrogen stream and to divide the stream into a first portion that is delivered to the mechanical compressor and a second portion that is not delivered to the mechanical compressor. None of the cited references disclose or suggest a fuel cell system with a hydrogen storage system that includes both an electrochemical compressor and a mechanical compressor, much less these compressors in a fuel cell system with the operative configuration recited in amended claim 1. In the Office action, Ogino and

Lomax are cited for disclosing the use of an electrochemical compressor. In particular, both references disclose the use of a hydrogen-selective membrane that is used to selectively divide the product stream from a hydrogen-producing region into a hydrogen-rich stream and a byproduct stream. Similar membranes are disclosed in the present application and in many of Applicants' existing patents. Hydrogen-selective metal membranes produce this hydrogen-rich stream through a pressure-driven separation process in which the mixed gas, or feed, stream is delivered under pressure to the membrane. The hydrogen-rich stream, which is formed from the portion of the mixed gas stream that passes through the membrane, has a lower pressure than the feed stream. As such, Applicants respectfully submit that a hydrogen-selective metal membrane is not fairly considered to be an electrochemical compressor. The membrane not only produces a lower pressure stream instead of a higher pressure stream, but also is not in any way an electrical device. Instead it is a metal membrane that selectively permits hydrogen gas to pass through, with this separation process being driven by a higher pressure mixed gas stream. For at least this additional reason, Applicants submit that claim 4 should be allowed. Claim 47 depends from claim 21 and also recites the inclusion of an electrochemical compressor. New claim 58 expressly recites the further combination of a hydrogen purification region upstream from a hydrogen storage system that includes an electrochemical compressor and a mechanical compressor. Claims 47 and 58 should be allowable for at least the reasons presented above with respect to claim 4.

Claim 21 depends from amended claim 1 and further recites that the fuel cell system includes a controller that controls the distribution of hydrogen gas in the fuel

cell system. Applicants submit that none of the cited references disclose such a controller, much less in the context of the fuel cell system recited in amended claim 1.

With the entry of the above amendments, and for the reasons discussed herein, Applicants submit that all of the issues raised in the first Office action have been addressed and overcome. If there are any remaining issues or if the Examiner has any questions, Applicants' undersigned attorney may be reached at the number listed below. Similarly, if the Examiner believes that a telephone interview may be productive in advancing prosecution of the present application, the Examiner is invited to contact Applicants' undersigned attorney at the number listed below.

Respectfully submitted,

KOLISCH HARTWELL, P.C.

A handwritten signature in black ink, appearing to read 'David S. D'Ascenzo', is written over a horizontal line.

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